Towards a Generic Model of Trust for Electronic Commerce

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Abstract
In this paper we present a generic model of trust for electronic commerce. The basic components of the model are party trust and control trust. We argue that an agent’s trust in a transaction with another party is a combination of the trust in the other party and the trust in the control mechanisms for the successful performance of the transaction. The generic trust model can be used for the design of trust related value-added services in electronic commerce. To illustrate this design use of the model we compare in this paper two activities in electronic commerce that require trust, namely electronic payment and cross-border electronic trade. We show with the model that these two activities actually require two different types of trust, and that complete different services are needed to create these different types of trust.

1. Introduction

1.1 Trust in Electronic Commerce
With the advent of Electronic Commerce many people have become interested in trust issues. Most people agree that in order for Electronic Commerce to become a success the people have to trust it. Trust in Electronic Commerce is therefore an important issue. The basic assumption of our model is that an individual will only engage in a transaction if his level of trust exceeds his personal threshold, which depends on the type of transaction and other parties involved in the transaction. Figure 1 gives a graphical representation of the generic trust model. In the center of this figure is the trustor's transaction trust; i.e. the mental state of the trustor that determines whether he has sufficient trust to engage in a transaction. The determinants of the trustor’s trust threshold are represented in the lower half of Figure 1. Several determinants for a person’s threshold can be distinguished. The potential profit for the person, the risk involved, the person’s attitude towards risk or risk propensity, i.e. risk seeking, risk neutral, risk averse are examples of such determinants. The upper half of Figure 1 represents the trust determinants such as the trust that the counter party in a transaction induces in the trustor, and the trust that control mechanisms induce in the trustor. By control mechanism we mean procedures and protocols that monitor and control the successful performance of a transaction.
In this paper we focus on the level of transaction trust, i.e. the trust that is needed to engage in a transaction. We investigate the constituents of the level of trust and we discuss how this level of trust in a transaction can be increased.

The generic trust model presented in this paper can be used for the design of trust related value-added services in electronic commerce. To illustrate this design use of the model we compare two activities in electronic commerce that require trust, namely electronic payment and cross-border electronic trade. We show with the model that these two activities actually require two different types of trust, and that complete different services are needed to create these different types of trust.
1.2 Why is Electronic Commerce not trusted?
Why is it that people would not trust Electronic Commerce in the first place? It has been argued that trust is a relevant factor in risky situations only [KK70], and to trust essentially means to take risks and leave oneself vulnerable to the actions of trusted others [H95]. The Electronic Commerce environment is obviously an environment with risk, simply because commerce in general involves risk.

Many of the risks can be explained by looking at the information available to the parties in a transaction. We can distinguish three important situations. The situation of perfect information in which all parties know everything that is relevant for a transaction. The situation of complete ignorance where none of the parties has information relevant for (a part of) a transaction. And the intermediary situation of information asymmetry in which one party has information that the other party does not have. This situation of information asymmetry is the most interesting one, because it may give rise to opportunistic behavior. Williamson [W75][W85] describes opportunism as ‘self interest seeking with guile’ and as making ‘self disbelieved statements’. In other words, trying to exploit the information asymmetry to your own advantage. The textbook example of opportunism is the situation of a used-car market. The seller knows the quality of the car while the buyer does not. The seller can try to exploit this information asymmetry by claiming a higher than actual quality and thus asking a higher price.

A distinction can be made between the case where the information problem arises before the parties agree to transact, ex ante, or the case where the problem arises after the transaction has been agreed, ex post. In the first case the problem is called hidden information and in the second case the problem is called hidden action. Hidden action can, for instance, occur when an insurance company has agreed to insure someone against damage to his house caused by fire. The insured could set his house to fire and then claim damages from the insurance company. The insurance company does not know who has set fire to the house and that information asymmetry harms her interests.

That the insurance company does not know who has set fire to the house illustrates the importance of (un)observability. Unobservability is a major reason for information asymmetries to exist. In our view unobservability plays an even more important role for Electronic Commerce than it does for more traditional commerce. The reason is that in Electronic Commerce direct observation, “with your own eyes and ears”, is often more difficult than in a traditional environment. As a consequence indirect observation, e.g. by means of statements from other parties about the present situation, becomes more important for reducing information asymmetries. It seems reasonable to assume that most people have more faith in their own direct observations than in the indirect
observations, which were made by others and communicated to them. Trust in Electronic Commerce could therefore be harder to achieve. It is clear that there is risk involved in Electronic Commerce. Therefore, people will have to take risk when they engage in Electronic Commerce transaction. People will have to believe that the risks are limited and under control before they actually take the risk, in other words before they trust.

2. The Determinants of Trust

2.1 Party Trust
Many definitions for trust have been proposed. We discuss some of those definitions to find some important issues. Mayer et al. define trust as “The willingness of a party to be vulnerable to the actions of another party based on the expectation that the other party will perform a particular action important to the trustor, irrespective of the ability to monitor or control that other party” [MDS95, 712]. Gambetta [G88] defines trust as “Trust is the subjective probability by which an individual A expects that another individual B performs a given action on which its welfare depends”. Both definitions clearly have a subjective view on trust. The first definition refers to “the willingness of a party” and the second one refers to the “subjective probability”. Just as we said that the level of trust considered sufficient is different for each individual, the level of trust a person has in a certain situation is different for each person. Another element that both definitions have in common is the action-perspective. The definitions use phrases like “perform a particular action” and “perform a given action”. This action-perspective contrasts with the information-perspective. Just as we can trust someone with respect to the performance of a particular action, we can also trust someone with respect to certain information provided. The information-perspective is included in the definition of trust by Cook and Wall [CW80] “The extent to which one is willing to ascribe good intentions to and have confidence in the words and actions of other people”. The kind of trust the authors define in the above definitions is what we call ‘trust in the other party’ or briefly “party trust”. We can see from the definitions that it is important to note that ‘party trust’ is subjective and that both an action and an information perspective should be distinguished. The definitions also show that trust is commonly seen as an interpersonal relation. One person trusts another person. This view is too restrictive for analyzing trust in Electronic Commerce. A person can also trust a machine or more relevant for Electronic Commerce an intelligent (software) agent. If you throw some coins in a candy machine, you trust the machine to give you the candy bar you selected. If you make a micro-payment to an intelligent agent to retrieve some data for you, then you trust the intelligent agent to give you the data. Some people find it counterintuitive to say that they trust an intelligent agent and object that it is not the intelligent agent itself that is trusted, but the owner of the intelligent agent. However, for the candy machine, which is also owned by a company, people usually do not have this perception problem.

2.2 Trust and control
An important concept in [GLF88][HL98][L79] is the duality between trust and control. In a given situation the trading parties can either directly trust each other or rely on functional equivalent control mechanisms, i.e. the procedures and protocols that monitor and control the successful performance of a transaction. In other words, if we do not trust someone we want to use control mechanisms instead. The relation between trust and control is usually taken to be a substitution or
complementary relation. The assumption of a substitution relation is, for example, clear in "legalistic remedies have been described as weak, impersonal substitutes for trust" [SR93]. The general idea is that the more there is of trust, the less there is of control and vice versa. This general idea is also expressed by Beamish "to reach a minimum level of confidence in cooperation, partners can use trust and control to complement each other" [B88]. In light of what we said in the introduction this means that if the level of trust is not above the threshold then trust should be complemented by control to reach the threshold level.

In contrast with this complementary relationship view is the idea of Das and Bing-Sheng Teng [DB98] that trust and control are parallel concepts. They write “We believe that this restrictive complementary relationship needs reassessment, because an open-ended supplementary one would more appropriately capture the nature of trust and control as parallel concepts”. In our opinion the following example clearly illustrates that trust and control are indeed parallel concepts. Assume that your video recorder is not working properly and you take it to a repair center. When you hand over your video recorder the repair center will prepare an intake form that you have to sign. One of the questions on this form is “Is there any visible damage?” The idea behind this question is obvious. The repair center wants to avoid a possible accusation that they damaged the product while being repaired. This question on the form that you have to sign is a control that the repair center uses. The restrictive complementary relationship would lead to the conclusion that the repair center does not have sufficient trust in you and therefore uses the control to complement the trust. However, it is very probable that the repair center did not even evaluate whether they trust you not to falsely accuse them of damaging your video recorder. They simply applied the control mechanism without evaluating their trust in you. Their level of trust in the control mechanism is sufficient to engage in the transaction irrespective of whether they trust or distrust you personally. This control mechanism is clearly not a substitute or complement for a lack of trust in you, because the trust in you is unknown.

The objection can be made that in fact the repair center does not trust you, because the repair center does not trust customers in general. Instead of considering you personally, the repair center has a certain level of trust in a group of individuals with a common characteristic, in this case the customer-role played.

We call this trust in a role or briefly ‘role trust’. Role trust plays an important part in electronic commerce and commerce in general. Trusted third parties (TTP) are often mentioned to resolve trust problems in electronic commerce. A TTP, e.g. a bank, is supposed to be trusted because of the role it plays in a commercial transaction. Which particular bank is used is not relevant.

The objection that the repair center does not trust you because it does not trust customers is, however, not necessarily valid. The point remains that the repair center probably has not even considered their levels of trust in you or in customers in general.

In internal auditing it is often assumed that people will show opportunistic behavior whenever they can. Therefore, control mechanisms are designed to detect, or rather prevent, all opportunistic behavior and (unintentional) errors without any reliance on trust. “According to Starreveld, internal control is needed when an organization has a delegated task structure which allows agents to establish commitments on behalf of the organization, to employ certain funds, goods or products or to store such items. The principal that has delegated such activities will have the evident need to control the agent that performs these activities.” [Bons97, p46] However, using a no-trust assumption does not mean that there is no trust!

2.3 Control trust

In the discussion of party trust we indicated that most scientists have a subjective view on trust. Every individual can have a different level of trust in identical situations. An individual’s level of trust in a situation depends among others on previous experiences and trust propensity, which are clearly subjective.
However, when it comes to control an objective view is often taken. For example, Bons [Bons97, p41] defines a trustworthy trade procedure as “a trade procedure that governs a transaction in which the risk of opportunistic behavior by one or more parties is present but which provides sufficient inter-organizational controls to limit this risk”. Although ‘sufficient’ could be interpreted as a subjective measure Bons continues with “this will result in a set of design principles on trade procedures, which specify in detail when a certain trade procedure has sufficient controls.” The set of design principles is clearly intended to be an objective measure for the trustworthiness of trade procedures.

The consensus seems to be that controls, whether considered a complement or supplement to trust, are objective. If there is not enough party trust in a certain situation, then some control mechanism is prescribed. For example, if you do not trust someone to pay for goods you consider supplying, then use a Letter of Credit. The control mechanism ‘Letter of Credit’ is supposed to supplement everybody’s party trust in such a way that everybody’s threshold is exceeded.

Is it not important to consider the level of trust a person has in a control though? I might not trust letters of credit, e.g. because I have the personal experience that letters of credit can be falsified. Therefore they do not help me to exceed my threshold. So it is not the control that supplements my party trust, but it is the trust in the control, control trust for short, which supplements my party trust.

Besides personal experiences we believe that the understanding of a control is an important determinant of control trust. The intuition is that if you fully understand a control mechanism, then you can evaluate the effectiveness of the control mechanism yourself. In that case you can reach a higher level of trust then when you can’t evaluate the effectiveness yourself because you don’t understand the control mechanism. For example, when you try to determine your level of trust in the SET protocol for electronic payments it is important for you to understand the SET protocol. If you understand the SET protocol you can get useful information by evaluating the protocol. The additional information can increase your level of trust in the SET protocol. If you do not understand the SET protocol then you cannot get any additional information that might increase your level of trust and you can only select a minimal level of trust based on this factor. (Note that other factors, such as public experience, might still give you a higher than minimal level of trust in the SET protocol).

**Party Trust + Control Trust = Transaction Trust**

We argued that trust and control are parallel concepts that supplement each other. We also argued that it is not control in itself that is important, but that the trust in a control mechanism is important. We define transaction trust as party trust supplemented with control trust. It is the level of transaction trust that a person has that should be above its threshold. The upper half of figure 1 shows the transaction trust broken down into the constituents, party trust and control trust.

### 2.4 The Objective and Subjective Aspects of Party Trust and Control trust

In addition to the fundamental difference between party trust and control trust, a more subtle distinction is made in Figure 1 between objective and subjective aspects of party trust as well as control trust. An aspect is objective if it depends on inter-subjective methods that are widely accepted by most people.

**Party Trust:**

*Objective aspects:*
- Social signs: uniforms of police officers and doctors etc. You trust someone’s medical advice, because he wears a doctor’s uniform and/or a stethoscope.
Subjective aspects:
- 'Good vibrations'; e.g. you trust a person without any earlier experience or interaction, simply because he gives you good vibrations. Some people will call this intuition.
- Personal experience; e.g. you trust a person based on a history of previous interactions and positive experiences. In none of these interactions the person deceived you.
- Communality; e.g. you trust the opinion of an expert, because others trust him too. (Typically, you are not expert enough to assess the quality of his opinion yourself, so you have to rely on your trust in the expert.)

Control Trust:
Objective aspects:
- Control assessment; e.g. you trust the controls, because you assessed them using widely accepted auditing principles and your assessment positive.

Subjective aspects:
- Understanding of controls; e.g. you trust a control system (e.g. the SET protocol for electronic credit card transactions), because you understand how it works.
- Communality; e.g. you assume that a control system protects you against fraud, because everybody around you is relying on the system to do this.

3 Mental model of Trustor’s trust

So far we have treated trust as a basic concept. If we take a closer look at the definitions presented in Section 1 we find that they contain several common elements that are used to build the concept of trust. One such common element is ‘expectation’. The expectation that a trustee will perform the action or provide reliable information is an important ingredient of trust. Expectation is also relevant for control trust. The expectation that the control mechanism has the desired effect, e.g. making the other party’s behavior more predictable. This expectation is something that takes place in the mind of the trustor. We call this the mental model of the trustor’s trust. The mental model of trust is not explicitly represented in Figure 1. Here we abstract from this mental model, because otherwise the model would be unnecessarily complicated for the issues that we want to address in this paper. To model the mental model of the trust of the trustor, we use the model of Castelfranchi and Falcone. Castelfranchi and Falcone [CF98] distinguish the following basic beliefs in the mental state of trust:

Competence belief: a positive evaluation of the other party is necessary, I should believe that the other party is useful for accomplishing my goal, that the other party can produce/provide the expected result, that the other party can play a role in my plan/action.

Dependence belief: the belief that the other party is either needed to accomplish my goal, or at least that it is better to rely than not the rely on the other party.

Disposition belief: the belief that not only the other party is able and can perform the action/task, but also that the other party is actually willing to perform the action/task.

Fulfillment belief: the belief that my goal will be achieved (thanks to the other party).

Although Castelfranchi and Falcone consider those beliefs basic ingredients of the mental state of trust, we need not consider them all when reasoning about or evaluating trust.
It is possible to evaluate the level of trust in another party, without having a dependence belief. There is no problem with saying that I do trust this person, but I decided to perform the action myself, e.g. for economic reasons. The dependence belief is important when the decision to actually trust the other party is made. With ‘actually trust’ we refer to the behavioral manifestation of trust, i.e. you delegate an action to the other party or you accept information from the other party. In other words, the situation “I’m trusting agent j to perform a particular action or to provide some information” should be distinguished from the mental state “I would trust agent j with regard to this particular action or some particular information”, which is an example of hypothetical trust. The dependence belief is demonstrated by including the other party in your plans to achieve a certain goal.

The fulfillment belief is only relevant in situations where you are actively trying to achieve your goals by using the other party. Whether the fulfillment belief is a necessary requirement for trust is questionable. Even though I believe that the other party is competent, willing and that I depend on the other party I could still have doubts about whether the goal will be achieved, simply because I know that it is hard to achieve the goal.

In summary, we consider the competence belief and the disposition belief necessary and sufficient conditions for hypothetical trust in the other party. We consider the dependence belief to be a necessary condition for actual trust in the other party. Note that having a competence, disposition and dependence belief is not a sufficient condition for actual trust, because a behavioral manifestation is also required. Although the fulfillment belief is relevant for trust it is neither a necessary nor a sufficient condition.

A basic assumption of the trust model is that party trust and control trust supplement each other. If there is not enough party trust, then trusted control mechanisms should be introduced to supplement the party trust. The basic beliefs that underlie party trust can give us a more sophisticated guideline for the kind of control mechanism that should be introduced.

A trustor could believe that the trustee is perfectly willing to perform a particular action (disposition belief), but he does not believe that the trustee is competent to perform the action. If we want to create party trust we should therefore aim to change the competence belief of the trustor. If the trustor, for example, does not believe that the trustee could pay for certain goods, then we could indicate that the trustor should contact a credit rating firm or ask for a bank guarantee. On the other hand, if the trustor has a positive competence belief (the trustee can pay), but no disposition belief (the trustee might not be willing to pay) the trustor could be advised to ask for (partial) prepayment or use a documentary credit procedure. In both situation there is no party trust. Examining the basic beliefs that underlie this no-trust situation, however, makes it possible to select the most appropriate control mechanisms.

4 Applications of the trust model

We explained in the introduction that trust and especially making people trust Electronic Commerce is important for it to become widespread and successful. We presented a model of trust in the previous sections. We now illustrate how we can use the model to compare and analyze two different cases, namely electronic payment and international electronic trade.

4.1 Trust in Electronic Payment

The history of trust in payment systems is characterized by a shift from communality trust via understanding trust back to communality trust again. For example, trust in the traditional credit card was primarily based on communality trust\(^1\). Communality, because since everybody was

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\(^1\) Another aspect was that the risk is reduced by the unwritten rule of most issuing banks that any suspect payment are rolled back upon request of the client and no further questions are asked. The client simply has to write a letter stating
using credit cards, very few people were questioning the security of the protocol used. When electronic versions of traditional payment systems were introduced complete new payment communities had to be initiated. With only a few electronic payment co-users new users could not rely on communality trust. So, the other route was chosen, to create understanding trust by explaining every minute detail of the cryptographic technology that is used to secure electronic payment. The problem here was that the technology (e.g. public key cryptography, SET protocol) was too complicated to be explainable on a wide scale to a large audience. Most people were left with the uneasy feeling that, first, mysterious things were going on that they could not understand. Secondly, what they did understand was that even the experts agreed that no electronic payment system was 100% secure. Interestingly, very few people make the comparison of electronic payment systems with the traditional credit card payment system that they do trust, and which is far less secure than even the weakest electronic payment systems. The current approach in electronic payment systems is to convince the public by massive introduction. For example, the SET initiative focuses more on getting the SET protocol used by a large number of companies that are already trusted by the general public in payment handling. The idea being that the public will be convinced by the massive scale of SET application. To sum up, if we view the development of credit card payments we observe a shift from communality trust for the paper-based credit card payments to an initial understanding trust approach for electronic payment tending now more towards a communality trust approach.

4.2 Trust in International Electronic Trade
It is well known that companies are very reluctant to establish new trade relationships via electronic networks. Hence, the initial expectation about electronic commerce that companies would operate much more globally due to electronic commerce technology has not borne out. There are various reasons for this reluctance, but in the case of cross-border trade a very important reason seems to be the lack of trust in electronic trade procedures and documents (see [Bons97], [BLW97] and [GLF98]). (Actually, results of a recent empirical study in [HL98] seem to indicate that the development of virtual organizations is much slower than expected, because of this trust problem.) The two most important causes for this lack of trust are the following. First, in most countries the electronic version of a paper-based contract does not have the same legal status as the paper version.² Hence, when you negotiate a contract electronically with a party in another country you do not know if this contract is legally binding for him. Secondly, the typical problem in international trade is the bewildering variety of different procedures and documents that are issued by each country. This variety is introduced sometimes for good reasons, sometimes just to protect the country's own trade. Some basic documents such as purchase order, invoice, pre-shipment notification are shared by most countries, but even then the precise details of these documents might vary from country to country. But the real problem is that every country has its own types of documents. Usually there are very strict local rules about the order in which these documents have to be issued and processed. This variety of documents and procedures creates a lack of trust, because it creates information asymmetry between buyer and seller that can be used for opportunistic renegotiation of the price of the goods. For example, if a seller wants to transport goods to the country of a buyer, but the import in this country is delayed by weeks or even months, because the buyer did not inform the seller about certain special documents that are needed to import these goods in his country, then the seller might be willing to sell the goods for a much lower price, if the buyer is able to arrange these missing documents swiftly. (The seller's willingness might be even greater if he hears that goods stored at the quay, but not imported will

² The current estimation is that this harmonization of electronic and paper-based contracts within the European Union will not be completed before 2006. World wide it will even take much longer.
be publicly auctioned after three months!) As long as these two trust problems are not settled people will be very reluctant to start new trade relations on the basis of electronic contracts. Hence, new trade relations will only be rarely established via electronic means.

The trust issue in international electronic trade is different from the one in electronic payment because of two reasons. First, the company that is considering a new trade relationship with a company in another country usually cannot benefit from the communality effects. His closest neighbor in his environment is typically his fiercest competitor. In contrast to the electronic payment user, the company has virtually no compatriots in his community. Hence, trust creation by communality does not work for international trade. The best option for trust creation in international trade seems to be understanding trust; i.e. make the parties understand the details of the trade procedures (see e.g. [BLW97]). For example, by having a central on-line data base, where everybody can obtain information about international trade documents and procedures for all countries in the world. This is a difficult method to create trust, but the only one that works for international electronic trade. Note that the services that have to be developed for trust creation are quite different for the electronic payment and the international trade case. Trust in international documents and trade procedures is primarily created by a service that disseminates information, whereas trust in electronic payment systems is created by massive adoption of these systems by trusted companies.

5. Conclusions
In this paper we have presented a generic model of trust for electronic commerce. The basic idea of the model is that an individual will only engage in a transaction if his level of trust exceeds his personal threshold, which depends on the type of transaction and other parties involved in the transaction.
We argued that the two basic components of the level of transaction trust are the trust in the other party and the trust in the control mechanisms and that both kinds of trust have objective and subjective aspects.
The generic trust model can be used for the design of trust related value-added services in electronic commerce. To illustrate this design use of the model we discussed two activities in electronic commerce that require trust, namely electronic payment and cross-border electronic trade. We have shown with the model that these two activities actually require two different types of trust, and that complete different services are needed to create these different types of trust.

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